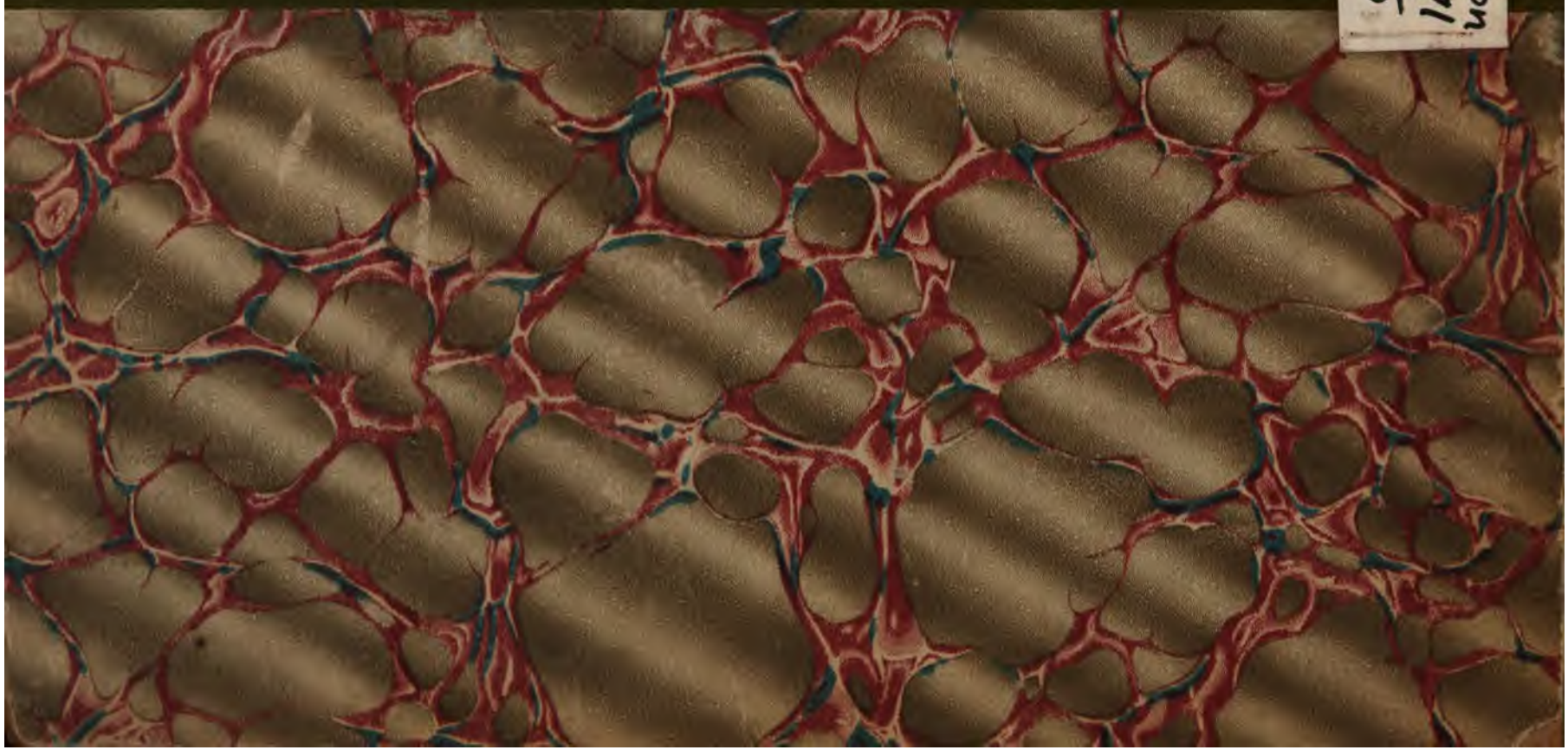
U.S. Tariff Comm. - Scientific Instruments
1919



UNITED STATES TARIFF COMMISSION, WASHINGTON

INFORMATION

CONCERNING

SCIENTIFIC INSTRUMENTS

PRINTED FOR USE OF

COMMITTEE ON WAYS AND MEANS

HOUSE OF REPRESENTATIVES

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UNITED STATES TARIFF COMMISSION.

OFFICE 1322 NEW YORK AVENUE, WASHINGTON, D. C.

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EDWARD P. COSTIGAN.

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LETTER OF TRANSMITTAL.

UNITED STATES TARIFF COMMISSION,
Washington, July 21, 1919.

The Committee on Ways and Means
of the House of Representatives:

I have the honor to transmit herewith, in accordance with your request, information compiled by the United States Tariff Commission on scientific instruments.

Very respectfully,

THOMAS WALKER PAGE,
Acting Chairman.

INTRODUCTION.

In response to the request of the Ways and Means Committee for information concerning scientific instruments, the Tariff Commission has compiled the following somewhat general and purely preliminary data. To a considerable extent material was obtained from replies to a questionnaire sent to the various sections of the Bureau of Standards and a circular letter sent to a number of manufacturers. Several of the important universities were asked to submit opinions regarding the repeal of the present duty-free clause. Excerpts presented as a part of this report have been made from the statements received by the commission from these various sources.

The extremely diverse nature of the products falling under such a general designation as "scientific instruments" renders general statements concerning the entire group of little value for the purpose of deciding on any rates of duty related to the competitive conditions which affect individual instruments. A more extended study, dealing with separate instruments or with well-defined classes of similarly placed instruments, is necessary before more determinative information can be submitted.

SCIENTIFIC INSTRUMENTS.

TARIFF PROVISIONS, ACT OF 1913.

Scientific instruments are provided for under so many sections of the tariff act of 1913 that it is impossible with brevity to reprint all references. Attention is more particularly called to the following illustrative paragraphs:

573. Philosophical and scientific apparatus, utensils, instruments, and preparations, including bottles and boxes containing the same, specially imported in good faith for the use and by order of any society or institution incorporated or established solely for religious, philosophical, educational, scientific, or literary purposes, or for the encouragement of the fine arts, or for the use and by order of any college, academy, school, or seminary of learning in the United States, or any State or public library, and not for sale, and articles solely for experimental purposes, when imported by any society or institution of the charcter herein described, subject to such regulations as the Secretary of the Treasury shall prescribe. (Free of duty.)

80. China and porcelain wares composed of a vitrified nonabsorbent body which when broken shows a vitrified or vitreous, or semivitrified or semivitreous fracture, * * * and all other articles composed wholly or in chief value of such ware, if plain white, or plain brown, not painted, colored, tinted, stained, enameled, gilded, printed, or ornamented or decorated in any manner; and manufactures in chief value of such ware not specially provided for in this section, 50 per centum ad valorem; if painted, colored, tinted, stained, enameled, gilded, printed, or ornamented or decorated in any manner, and manufactures in chief value of such ware not specially provided for in this section, 55 per centum ad valorem.

92. Lenses of glass or pebble, molded or pressed, or ground and polished to a spherical, cylindrical, or prismatic form, and ground and polished plano or coquill glasses, wholly or partly manufactured, strips of glass, not more than three inches wide, ground or polished on one or both sides to a cylindrical or prismatic form, including those used in the construction of gauges, and glass slides for magic lanterns, 25 per centum ad valorem.

93. Opera and field glasses, optical instruments, and frames and mountings for the same; all the foregoing not specially provided for in this section, 35 per centum ad valorem.

94. Surveying instruments, telescopes, microscopes, photographic and projection lenses, and frames and mountings for the same, 25 per centum ad valorem.

95. Stained or painted glass windows, or parts thereof, and all mirrors, not exceeding in size one hundred and forty-four square inches, with or without frames or cases; incandescent electric-light bulbs and lamps, with or without filaments; and all glass or manufactures of glass or paste, or of which glass or paste is the component material of chief value, not specially provided for in this section, 30 per centum ad valorem.

161. Watch movements, whether imported in cases or not, watchcases and parts of watches, chronometers, box or ship, and parts thereof * * * whether separately packed or otherwise, not composed wholly or in chief value of china, porcelain, parian, bisque, or earthenware, 30 per centum ad valorem.

167. Articles or wares not specially provided for in this section; if composed wholly or in part of platinum, gold, or silver, and articles or wares plated with gold or silver, and whether partly or wholly manufactured, 50 per centum ad valorem; if composed wholly or in chief value of iron, steel, lead, copper, brass, nickel pewter, zinc, aluminum, or other metal, but not plated with gold

or silver, and whether partly or wholly manufactured, 20 per centum ad valorem.

380. Photographic cameras, and parts thereof, not specially provided for in this section; photographic dry plates, not specially provided for in this section, 15 per centum ad volorem.

DESCRIPTION.

The articles included under the term "scientific instruments" are many and diverse, and are not provided for as such in the act of 1913. Paragraph 573 applies to articles specially imported by the specified institutions, and court interpretation has laid stress on the intended use of the article, rather than its inherent character.

Scientific instruments are, in general, characterized by the high degree of sensitiveness and dependability with which they serve their purposes. Most important among them are engineering, physical, chemical, and medical instruments of various kinds, used for the measurement of weight, volume, length, heat, temperature, light, color, and time. A large portion of scientific instruments are electrical, either through their employment in relation to electrical phenomena or by reason of the use of electricity in the determination of other phenomena. With the application of scientific methods to manufacturing there has developed an extended industrial demand for instruments which were formerly of little service outside the student laboratory and that devoted to pure science.

The Tariff Commission has prepared separate information, which for the most part is not repeated under this title, on optical glass and chemical glassware, surgical instruments, and draftsmen's instruments.

THE DOMESTIC INDUSTRY.

Statistics of the industry are first given for the year 1849, when the value of "electromagnetic, mathematical, and surgical instruments" was somewhat less than $1,000,000. The industry has grown rapidly since 1904, the value of professional and scientific instruments[1] manufactured in 1914 ($17,500,000) being over three times as great as that 10 years before.

Materials.—The metals and glass are the most important materials in the construction of scientific instruments. Porcelain, wood, rubber, and other insulating materials of various kinds; quartz, feldspar, and calcite are illustrations of the many materials contributing to the various final products.

Equipment, methods, and processes.—In general, the methods and processes used in the manufacture of scientific instruments are the same in the United States as abroad. One manufacturer says:[2]

> The materials, equipment, and methods of production in this country do not differ from those abroad, except that if we can get into quantity production, it will be best for us to "tool up," so that we may do more machine work and thus cut down the great handicap that we have in the matter of costs.

Another manufacturer suggests a difficulty which one branch of the industry has to contend with in building up efficient production methods:[3]

> Owing to the limited demand for scientific instruments, balances, weights, and surveying equipment, etc., the methods and conditions of production in

[1] Including medical and surgical instruments.
[2] Letter of the Central Scientific Co., July 7, 1919.
[3] Letter of William Ainsworth & Sons, manufacturers of weights and balances, July 8, 1919.

this country do not differ greatly from those abroad, hence the quantity produced does not enable manufacturers to put this industry on the same basis as the typewriter, adding machine, or automobile industry.

Organization.—Many firms manufacture scientific instruments as their sole product; many are engaged in the production of single kinds of instruments, such as balances or thermometers. However, production is not confined to these groups. For instance, some electric companies manufacturing a general line make instruments which may be classed as scientific.

The census lists 197 companies, with capital of $13,000,000, as producers in 1914 of professional and scientific instruments (excluding medical and surgical instruments).

The market for instruments of very high precision is extremely limited. These are chiefly used for testing other instruments, and generally a small quantity suffices. European makes of such instruments predominate in our domestic markets.

Geographical distribution.—New York, Illinois, Pennsylvania, and Massachusetts lead in domestic production. In 1914 these States furnished approximately 70 per cent of the professional and scientific instruments manufactured in the United States.

Production and consumption.—General statistics of the production and consumption of scientific instruments are not of great value because of the great diversity of the instruments included, and variations which may arise from the inclusion of different classes of instruments in the figures compared. In addition, statistics of imports are not complete, for dutiable instruments—imported for the private laboratory or for industrial uses—are separately specified in a few cases only. The statistics under duty-free imports contain, in addition to the instruments under consideration in this report, (1) medical and surgical instruments, (2) chemical glassware, (3) chemicals, and (4) certain other articles for the use of the specified institutions. In 1914 duty-free imports amounted to $704,000, exports (excluding medical and surgical instruments) to $1,550,000, and production (excluding medical and surgical instruments) to $14,600,000. Even if half of the instruments paid duty,[1] imports were still less than exports. The latter formed approximately 10 per cent of the production. The war has increased exports and decreased imports.

While in the case of some instruments the United States, prior to the war, produced none but imported them, in other lines the domestic industry both supplied our domestic market and exported. Some foreign instruments of still other kinds, in which there was domestic production, were also on the market. The following lists classify certain instruments on this basis, and show changed conditions since the outbreak of the European war:

[1] Assuming this to be the case, the $1,400,000 figure, for purposes of comparison, is too large, since it is based on duty-free imports under paragraph 573. This includes, in addition to scientific instruments, the articles mentioned above.

List of the different kinds of scientific instruments in use in the United States, showing the development of the industry since the outbreak of the war.[1]

A. THOSE ALMOST WHOLLY OF FOREIGN MAKE PRIOR TO THE WAR.

Instrument.	Kind.	Comments of—	
		The Bureau of Standards (June 26, 1919).	The manufacturers (June–July, 1919).
Aero altimeters		[2]	Now obtainable of United States manufacture.
Aero barographs			
Balances (see under C)	Schopper paper scale		
Barometers (see under C)	Primary standard	Probably could not be purchased in the United States to-day.	
Cathode ray tubes (Braun tubes)		Not made in United States to-day.	
Chronographs	Geneva		
Chronometers		Manufacture of genuine marine chronometers undertaken by one American firm.	
Colorimeters	Of the better grades	United States manufacture contemplated.	Bausch & Lomb Optical Co. state none, or very negligible amount, made prior to war; will manufacture.
Compasses	Pocket	[2]	Now obtainable of United States manufacture.
Conductivity bridges	Precision		
Cooling curve recorder	Saladin		
Direct-vision prisms			
Electrical conditioning ovens	For paper and textiles.		
Eectric furnaces	Laboratory	Now made in sufficient quantity in the United States.	
Electrical frequency meters	"Frahm" (reed type)		
Electrical measuring instruments	Hot wire and hot strip	United States make of a new type of thermal instrument is an improvement on those formerly imported.	
Electrometers		United States make now being advertised.	
Filtration apparatus	Ultra	Not made in United States to-day.	
Fluorite plates and prisms			
Fluxmeters			
Galvanometers (see under C)	Thomson, thermo, Einthoven	Now obtainable of United States manufacture.	
Gauge blocks	Precision	....do....	
Hardness testing machines	Brinell	Imports due to special quality of the Brinell machine.	
Interferometers (see under B)	Except Michelson	Not now manufactured in the United States; at least two firms are attempting to manufacture.	
Do	Pulfrich		
Do	Zeiss-Rayleigh		
Lenses	For textile microscopes		
Lenses (see under C)	Achromatic, especially of quartz-fluorite		
Length standards	Metric and English of the highest precision.[3]		
Mathematical instruments (see under B and C)	Millionaire computing machine	United States manufacture contemplated.	
Micrometers	Schopper, for paper testing		
Micrometers (see under C)	Best quality microscope		
Microscopes	Ultra	Not now manufactured in the United States.	

[1] Prepared from the replies to a questionnaire sent to the Bureau of Standards by the Commission, June 26, 1919.
[2] Added by manufacturer.
[3] Extremely few needed to satisfy even world demand.

List of the different kinds of scientific instruments in use, etc.—Continued.

A. THOSE ALMOST WHOLLY OF FOREIGN MAKE PRIOR TO THE WAR—Continued.

Instrument.	Kind.	Comments of—	
		The Bureau of Standards (June 26, 1919).	The manufacturers (June–July, 1919).
Microscopes (see under C).	Zeiss		
Milliammeters	Paul unipivotal		
Milliammeters (see under C).	Special triple range instruments (English).		
Millivoltmeters (see under C).	Siemens & Halske		
Nicol prisms		Not now manufactured in the United States.	
Paper-folding endurance testers.	Schopper	There has been a desire to develop.	
Photometers [1]		Not now manufactured in the United States.	
Photometers	Polarization	Will be manufactured by a United States firm within a year.	
Photometers (see under C).	Marten's; spectro	Must still be imported; United States manufacture contemplated.	
Polarimeters			Wm. Gaertner & Co. state that these instruments were not made in United States prior to war.
Polariscopes [1]		Various United States manufacturers now attempting to produce. (In general, "All instruments having polarizing parts, i. e., Nicol prisms, Wollaston prisms, and Rochon prisms" in class A.)	
Polariscopes			Bausch & Lomb state that none of a negligible quantity made prior to the war; will manufacture.
Polariscope tubes		Now obtainable of United States manufacture.	
Porcelain	Laboratory—Marquardt, Berlin.	United States make now better than German; United States porcelain suffices for all needs now.	Charles Englehard states that very high-grade refractory porcelains suitable for pyrometric apparatus not produced in United States, 1914; imported had higher deformation points, better mechanical qualities, was more impervious to gasses; United States porcelains now equal, possibly excel, quality of those formerly imported.
Porcelain tubes		Quality of United States make now just as good as that formerly imported.	
Potentiometers (see under B and C).	Wolff	Imports due to better quality; both better and cheaper (duty free) than United States make.	
Potentiometers	Precision		
Precision cells			
Psychrometers	Assman; Fuess		
Quartz (see under C)	Fused optical	Fair grade now made here.	
Quartz glass, plates, lenses, and prisms.			
Refractometers [1]		Various United States manufacturers now attempting to produce.	Wm. Gaertner & Co. state these not made in United States prior to war. Bausch & Lomb Optical Co., same; they will manufacture.

[1] Listed in the catalogue of the Scientific Materials Co., 1919, as not made in the United States.

List of the different kinds of scientific instruments in use, etc.—Continued.

A. THOSE ALMOST WHOLLY OF FOREIGN MAKE PRIOR TO THE WAR—Continued.

Instrument.	Kind.	Comments of—	
		The Bureau of Standards (June 26, 1919).	The manufacturers (June–July, 1919).
Refractometers	Pulfrich and Abbe		
Rochon prisms			
Rotameters (see under B—Gas engineering instruments).		A gas-flow measuring instrument, made only in Germany.	
Saccharimeters		Various United States manufacturers now attempting to produce.	Wm. Gaertner & Co. state these not made in United States prior to war. Baush & Lomb Optical Co., same; they will manufacture.
Silica ware		United States make now better than German, formerly imported.	
Spectrometers (see under C).	Mirror		
Spectrographs	Precision	Not made in United States to-day.	
Selenium cells		Various United States manufacturers attempting to produce.	
Spectroscopes (see under C).	Better quality	United States manufacture contemplated.	
Standard cells	Portable Weston	Now obtainable of United States manufacture.	
Stop watches		Probably could not be purchased here.	
Tachometers (see under B).	Hand	Not made in United States to-day.	
Tensile testing machines.	Fo ; paper (Schopper).	There has been a desire to develop United States manufacture.	
Thermo elements		Now made satisfactorily in the United States.	
Thermometers (see under B and C).	Inclosed scale (paper or porcelain), mercury in glass (chemical, Beckman, ordinary laboratory).	Beckman thermometers now manufactured in this country.	
	Pentane and toluene glass.		
Thermopiles			
Vacuum apparatus (see under C).	Grade high		
Voltmeters	Electrostatic, of certain types.	Electrostatic voltmeters of certain types are not yet made in the United States, and can be procured only from abroad, particularly from France.	
Volumeters	Seger	Now made satisfactorily in the United States.	
Wollaston prisms			
Wire	Bismuth		

B. THOSE ALMOST WHOLLY OF DOMESTIC MAKE PRIOR TO THE WAR.

Alundum refractories			
Arc lights	High intensity		
Bursting strength testers.	For paper		
Calipers	Vernier and micrometer.		J. T. Slocomb Co. states that it understands there was very small German import prior to war.
CO_2 recorders			
Diffraction gratings			
Electron tubes		Quantity made here prior to the war small; now made also in England, France, and Germany.	
Flash point apparatus			
Gas analysis apparatus			

List of the different kinds of scientific instruments in use, etc.—Continued.

B. THOSE ALMOST WHOLLY OF DOMESTIC MAKE PRIOR TO THE WAR—Contd.

Instrument.	Kind.	Comments of—	
		The Bureau of Standards (June 26, 1919).	The manufacturers (June–July, 1919).
Gas-engineering instruments.		Practically all; imported, merely for comparison with domestic make, [illegible] (See	
[illegible] glower lamps.			
Photographic outfits	Micro		
Potentiometer (see under A and C).	Portable		
Rare gas lamps			
Relays			
Standard cells			
Tachometers (see under A).	Other than hand		
Telephone amplifiers	Vacuum tube	Now manufactured abroad	
Temperature control apparatus.	Automatic		
Tension meters			
Testers for bursting strength of paper.			
Testing machines for materials of construction.			
Thermocouples (see under C).	Vacuum		
Thermometers (see under A and C).	Clinical thermometer of the etched stem type.		
	Industrial, of Hohman & Maurer type.		
	Indicating and recording of vapor pressure.		
	Liquid filled		
	Metallic expansion		
	Thermocouple and resistance.		
Transformers			
Viscosimeters			
Water meters			
Wire	Base metal thermocouple.	[1]	Charles Englehard states importation has never been general.

[1] Added by manufacturers.

List of the different kinds of scientific instruments in use, etc.—Continued.

C. THOSE OF BOTH FOREIGN AND DOMESTIC MAKE PRIOR TO THE WAR.[1]

Instrument.	Kind.	Comments of—	
		The Bureau of Standards (June 26, 1919).	The manufacturers (June-July, 1919).
Ammeters		Both high grade and very low grade imported.	
Anemometers		Imports due to quality	Central Scientific Co. states that production was limited prior to the war.
Balances (see under A)		Import high precision and ordinary laboratory: United States specialty, assay balances. Considerably increased production since the beginning of the war.	Central Scientific Co. states that production was limited prior to war; Christian Becker (Inc.) reports fourfold increase in production since 1914.
Barometers (see under A).	Aneroid	About as many surveying and weather aneroids imported as made.	Central Scientific Co. states that production of barometers was limited; Wm. Ainsworth & Sons, Henry J. Green, C. J. Tagliabue Co., state that aneroid barometers were not produced in the United States prior to war.
Calorimetric apparatus.			
Cameras		Imports due to quality and special characteristics: United States could get along without imports.	
Compressometers		Imports due to special characteristics.	
Condensers	Electrical	American make now as satisfactory as foreign.	
Deflectometers		Imports due to special characteristics.	
Dividing engines		Only made as "special" in United States, hence of higher price.	
Electric current meters.		Imports due to quality	
Electric ovens			
Extensometers		American make of less accurracy than the imported (Ewing) in use since the beginning of the war.	
Field glasses			
Fire-control instruments.		Imports due to quality; great increase in the United States since the beginning of the war; United States could get along without imports.	
Galvanometers (see under A).		Import high grade; United States high-grade instrument now made.	
Gas and vapor tubes for the production of certain spectral lines.		Imports due to quality and special characteristics; United States could get along without imports.	
Inductance coils			
Length comparators			
Lenses	Achromatic glass		
Lenses (see under A)	Photographic	Imports due to quality	
Mathematical instruments (see under A and B).	Cylindrical slide rule	Imported English of better quality.	
Mercury vapor lamps	Quartz	United States manufacture now superior to foreign.	

[1] There has been, in general, a large increase in the United States production of these articles since the outbreak of the war.

List of the different kinds of scientific instruments in use, etc.—Continued.

C. THOSE OF BOTH FOREIGN AND DOMESTIC MAKE PRIOR TO THE WAR—Contd.

Instrument.	Kind.	Comments of—	
		The Bureau of Standards (June 26, 1919).	The manufacturers (June-July, 1919).
Micrometers		Imports of ordinary grades very small.	T. R. Almond Manufacturing Co. states that there was attempted introduction from Germany, 1913-14.
Micrometers (see under A).	Microscope	Imported better made and more accurate.	
Microscopes (see under A).		Imports due to quality and special characteristics; United States could get along without imports.	
Do	Metallographic	United States make not equal to foreign previously imported.	
Do	Micrometer		
Milliammeters	Except as in A		
Millivoltmeters	do		
Optical clamps, benches, and parts.		Imports due to quality and special characteristics; United States could get along without imports.	
Paper condensers	Electrical		
Perimeters		(1)	Manufacture limited prior to war.
Permeameters			
Photometers (see under A).	Portable	Imports due to special quality.	
Photometer heads and standard bars.		do	
Planimeters		(1)	Imported from Switzerland because of mechanical excellence and low price.
Potentiometers (see under A and B).	Except as in A	Considerably increased United States production; that of United States manufacture not equal to Wolff.	
Projection instruments		Imports due to quality and special characteristics; United States could get along without imports.	
Pyrometers			Charles Englehard states: Small export, large import, 1914; largely increased export, 1918. Import due to lower price for better grade; United States instruments now superior. Thwing Instrument Co. states that 10 years prior to war, all imported; in 1906, one-third of consumption made here; in 1914, 80 per cent; exports equalled imports.
Do	Optical		
Pyrometric apparatus			
Quartz lamps		United States manufacture now superior to foreign.	
Quartz material (see under A).	Fused		
Resistances	Resistance bridges, boxes, units, Wheatstone bridges, resistance standards, precision resistances, wire resistances (Rühstrat type).		

1 Added by manufacturers.

List of the different kinds of scientific instruments in use, etc.—Continued.

C. THOSE OF BOTH FOREIGN AND DOMESTIC MAKE PRIOR TO THE WAR—Contd.

Instrument.	Kind.	Comments of—	
		The Bureau of Standards (June 26, 1919).	The manufacturers (June-July, 1919).
Rheostats		Imports due to special quality; price of laboratory rheostats bought here high.	
Spark gaps			
Spectrometers	Except as in A	"A few cheap, inaccurate instruments made in this country."	
Spectroscopes (see under A).	For schools and colleges.		
Telescopes		Imports due to quality and special characteristics; United States could get along without imports.	
Tensile strength testing machines.	For textiles	Imports due to "prejudice."	
Thermoscopes			
Thermocouples	Except as in B		
Thermometers (see under A and B).	Etched stem mercury in glass of all types.	The production has been greatly increased since the beginning of the war.	Union Thermometer Co. states that imports of glass thermometers exceeded production and were due to the cheapness of the product. Central Scientific Co. states that production was limited prior to war. Taylor Instrument Cos. states that imports were due to lower price.
Vacuum apparatus (see under A).			
Vacuum pumps		United States make now superior to foreign.	
Vacuum-walled vessels	Glass	Imports of high grade from Germany; now made at the bureau; ordinary food container made in the United States; United States superior in Dewar bottles and flasks.	
Do	Metal	England makes the better quality, United States the inferior.	
Voltmeters		Imports of very low-grade and of high-grade instruments.	
Wattmeters			
Wavemeters		United States make now as satisfactory as foreign.	
Weights			
Wire	Resistance		
Do	Platinum		Charles Englehard states that platinum and platinum-rhodium thermoelement wire of sufficient quality for pyrometric purposes was not produced in United States in 1914; foreign had greater chemical purity, insuring greater accuracy, greater exchangeability, longer life.

Exports.—Figures for domestic exports are available from 1913 to 1918. In the fiscal years 1913 and 1914 (not affected by war conditions), exports of scientific instruments (excluding medical and surgical instruments) averaged $1,600,000. After the outbreak of the

war they increased, reaching $5,500,000 in 1917. A large portion of these increased exports consisted of instruments for direct military use, such as range finders.

In 1913–14, Canada and England, in approximately equal amounts, took somewhat less than two-thirds of these exports. Cuba, Brazil, Argentina, and Japan also were important markets. In 1917–18 the first two countries took an increased amount, which, however, formed less than half the total exports. Increases had been general in the value of the goods sent to the other countries.

In the twelve months ended June 30, 1914, Germany took over $88,000 worth of our optical instruments.

FOREIGN PRODUCTION.

Germany has been the most important foreign producer. England, France, Switzerland, Austria-Hungary, the Netherlands, and Sweden also produced scientific instruments.

IMPORTS.

Statistics are presented here for duty-free imports only. They include many articles not properly classed as scientific instruments. Duty-free imports were valued at $545,000 in 1910 and $704,000 in 1914. They decreased in the following years, falling to $57,000 in 1917.

In the five years preceding the outbreak of the war, 1910–1914, Germany furnished approximately 80 per cent of the duty-free imports. England, France, and Austria-Hungary were next in importance. England and France now lead, having furnished slightly less than 40 per cent of these imports in the years 1917–18.

The importation of scientific instruments has been steady and has arisen from a number of different causes.

Prior to the war, some classes of scientific instruments which were used in this country were not produced here, but were entirely imported. Among such instruments may be mentioned chronometers, hot-wire electrical instruments, polariscopes and the polarizing parts of such instruments, porcelain, and precision spectrographs. In the case of instruments of the very highest precision there is demand for an extremely small number.

Other classes of instruments, of which there was some manufacture in this country, were imported because of the lower price of the imported article. This was true of certain balances and weights of not the highest precision and of ammeters and voltmeters of low grade, thermometers, and others.

A third cause, greater convenience in use, which in times past often led to the preference of the foreign-made instruments, is illustrated in the case of balances and weights. The German balances were frequently equipped with devices by which the easy and expeditious handling of weights, and thus a greater speed in weighing, were obtained.

Statements have been received from the various sections of the Bureau of Standards concerning the reasons why certain instruments were imported. The Paper Section says:

In regard to paper-testing instruments, imported articles are largely used because there are none of domestic manufacture. The machines of German manufacture seem to be of hand construction and parts are not interchangeable.

The Dispersoids Section states that the imports of instruments were due chiefly to special quality and characteristics.

But in addition, these special instruments could not have been made in the United States of America as cheaply, because of the small demand which does not permit the economy of quantity production.

TARIFF HISTORY.

Paragraph 573 of the act of 1913 exempts from duty all philosophical or scientific apparatus, utensils, or instruments for educational and like institutions. This exemption dates back to the act of 1790. Enlargements of the classes of goods or institutions were made in the acts of 1816, 1824, 1841, and 1842. The provision was omitted from the act of 1846 and also from 1864 to 1870, since which time free entry has been uniformly accorded.

Three rules of construction have competed, each at times successfully, in litigation. First, intrinsic character of the article; second, chief use of the article; and, third, intended or actual use of the particular importation. The last was held by the Court of Customs Appeals to be the proper rule. (United States *v.* Kastor, 6 Ct. Cust. Appls., 52.)

Under the rule of actual or intended use, irrespective of the nature of the article, any article enumerated in the tariff act might be regarded as philosophical or scientific for the purposes of paragraph 573. All articles not enumerated fall within some general or catch-all clause, such as paragraph 167, for manufactures of metal not specially provided for.

COMPETITIVE CONDITIONS.

The diverse nature of the articles included under scientific instruments—ranging from the large and heavy machines used in the testing of construction materials to those of great delicacy for the measurement of light, distance, and electricity—makes general statements misleading as to the competitive conditions in the industry.

This much may be said, however: Wherever there is a large demand for certain instruments, making it possible to manufacture them in fairly large quantities, the American manufacturer has an advantage arising from large-scale methods of production. Such conditions are usually present when the instruments have a wide industrial use. Quantity production has been attained in ammeters and voltmeters, pressure gauges, and to some extent in thermometers and weights and balances.

On the other hand, in the case of many scientific instruments, there is so small a demand—and so few are actually in use—that the older and established industries of Europe, with their highly skilled and relatively low paid labor, have heretofore produced at less cost. The foreign industries have given more attention to details and small orders than the American manufacturer. An additional advantage

has consisted of the fact that such instruments are of high precision, often requiring handwork of high skill, developed among European workers through successive generations. Such advantages have gained for European instruments a reputation for quality against which the American producers have encountered difficulty in making headway.

Instruments of this class are often used exclusively in research work, and not to a great extent in private or industrial laboratories. The free admission of instruments for educational uses has applied at the point where the American producer is relatively less efficient. Many such instruments enter under the provision for free admission of instruments and apparatus for educational and other institutions.

European industries have developed scientific instruments of the best quality—and highest precision—and their market, although from the nature of the article small, is world wide. There has been some development, also, in cheap articles of inferior quality, such as cheap ammeters and voltmeters and cheap thermometers.

Another consideration bearing on instruments of this class is the long and laborious training necessary to develop the scientific knowledge and skill requisite to their production—such production being, finally, for an extremely small demand. Such knowledge is often confined to a few men, who have devoted years to the particular line of work by which the instrument is produced, and is to be gained by others only through a similarly long course of training. Braun tubes may be given as an illustration.[1] They are not made in this country, and the knowledge of their manufacture is confined to a few German scientists, who supply the demand for them.

The Precision Instrument Co. states:[2]

> In the production of instruments, the engineering cost of development and design and the labor cost of assembly and test are very large in comparison with the cost of material, etc. The increased cost of manufacturing instruments in this country over that in England and Germany is due to the much higher wages paid to skilled mechanics, and the more generous salaries of technically educated men. This was true before 1914 and will evidently be equally true in the future.
>
> Instruments can be built in this country at least equal to those made abroad if equal time and labor are expended on the development and design and on the assembly and test before leaving the factory. In order to compete with foreign manufactures, some of the above-mentioned expenses may have been saved at times, to the detriment of the American-made instrument. In such cases, the foreign instruments would show up better, and thus lead to the impression that equally good instruments could not be made in this country.

WAR DEVELOPMENTS.

The outbreak of the war, followed by a large decrease in the importation of instruments, affected domestic production in varying degrees. The production of those instruments, which, prior to the war, were both made in this country and imported, has been greatly stimulated. Instruments which were directly needed for military and naval purposes have been manufactured in large quantities. Thus the production of optical instruments, such as range finders in military operations, and field glasses, has been greatly increased. The basic element of such instruments, optical glass, formerly imported in large quantities, is now extensively manufactured here.

[1] Suggested by the Bureau of Standards. [2] Letter, July 7, 1919.

This industry is the subject of another report of the Tariff Commission, entitled "Optical Glass and Chemical Glassware."

The production of various aeronautical instruments has thus been stimulated. Precision gauge blocks, necessary as reference standards to secure accuracy in the making of munitions, and other commodities where the assembling and accurate fitting together of parts manufactured in different factories was necessary, have been developed by the Bureau of Standards. Such blocks were formerly made only in Sweden.

Scientific instruments for industrial uses, which were previously entirely imported, and for which the war produced no direct demand, have been developed in this country in varying degrees. Polariscopes and polariscope prisms have not been actually produced, but their manufacture is contemplated by at least one company. Concerning precision instruments for measuring the strength and weight of paper, the Thwing Instrument Co. states:[1]

> Before the war all of this line of apparatus was of European manufacture, and even with the duty prevailing, the line did not look attractive to American manufacturers. During the war, however, this source of supply was entirely cut off, while the demand for such instruments, owing to the high price of paper and the rapid development of scientific methods in the paper industry, was urgent, with a willingness to pay prices somewhat higher than formerly prevailing. Under this stimulus some entirely new instruments have been developed, and marked improvements have been made on the old German instruments. The magnitude of this business is as yet not great, but it is an example of what may be done in America when we are once freed from the notion that instruments of precision must come from abroad.

In many cases, however, the manufacture has not been undertaken in this country. A representative of the Dispersoids Section of the Bureau of Standards states, relative to instruments under observation by that section which were entirely of foreign make prior to the war:[2]

> What could not be obtained from Germany has not been manufactured elsewhere. Perhaps this is due to the unsettled conditions, but I suspect that American manufacturers will not bother with special research apparatus which has little market.

The Spectroscopy Section says that there has been "practically no change" in the grouping of instruments according as they were entirely of foreign make prior to the war, entirely of domestic make, or both of foreign and American manufacture. The Colorimetry Section says, of the same grouping, that there has been "no actual change yet."

The Radio Communication Section presents a detailed account of the changes which have taken place in the manufacture of scientific instruments with which it deals:

> Hot-wire and hot-strip electrical measuring instruments were prior to 1914 procured almost entirely from Hartmann & Braun, of Frankfort, Germany. They can now be secured from several American manufacturers. The larger scale instruments of American make, covering a range of several amperes, are probably more satisfactory than the German instruments. It is doubtful whether the low-scale instruments of American make are at the present time as satisfactory as those formerly made by Hartmann & Braun. This bureau gave to one American manufacturer a Hartmann-Braun instrument to copy, and a fairly satisfactory product was produced.

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[1] Letter, July 2, 1919.

[2] Ultramicroscopes, Marten's photometers, special micriscopic apparatus, ultrafiltration apparatus, Nicol prisms, precision chemical glassware.

Before the war the Signal Corps and some other Government departments bought variable air condensers, wavemeters, and other radio apparatus made by the Telefunken Co., of Germany. Condensers and wavemeters of American make can now be secured which are as satisfactory as the Telefunken instruments. These instruments were made in the United States to some extent prior to the war.

Thermo-elements and thermo-galvanometers, formerly secured almost entirely from Europe, are now made satisfactorily in this country.

Electrostatic voltmeters of certain types are not yet made in the United States, and can be procured only from abroad, particularly from France.

Before 1914 the manufacture of the electron tube (vacuum tube) for use in radiotelegraphy was very largely confined to the United States, and even here it was small in comparison with its present importance. These tubes are now made to a very considerable extent in England, France, and Germany. The war resulted in an enormous increase in the electron tube industry in the United States.

Cathode-ray tubes (Braun tubes) were before the war secured only from Germany, and at the present time, as far as we know, Germany is still the only source. This bureau has been obliged to build its own Braun tubes with such materials as it could secure.

Einthoven galvanometers could formerly be secured only from abroad, from the Cambridge Scientific Instrument Co. They are now being made also by C. F. Hindel, of New York.

Before the war, potentiometers and resistance boxes made by O. Wolff, of Berlin, were very satisfactory and could be secured at reasonable prices. They were both better and cheaper (on basis of import duty free) than these instruments of American make.

It is probably true that instruments for use in a radio research laboratory can be procured more easily from American manufacturers because of the fact that many radio instruments for use in a research laboratory are the same as those used on a fairly large scale for commercial purposes in commercial radio stations.

VARIOUS TARIFF VIEWS.

As has been stated, the only place in which scientific instruments have been grouped together is in paragraph 573, providing for their free admission when imported by educational and certain other institutions and societies, for use and not to be resold. Instruments for individuals and for industrial purposes enter under various paragraphs of the act. Points of tariff interest are the free admission of such instruments for educational institutions, the desirability of a separate grouping of such articles, and the rate or rates of duty. On these subjects opinions have been expressed by the Bureau of Standards and by manufacturers.

The Radiometry Section of the bureau states:

Many of the items mentioned above are not used extensively, and on account of heavy overhead charges would cost more to manufacture here than abroad, where they are already equipped. Firms, e. g., Adam Hilger, London, have already raised their prices, and a tariff will increase the cost. The free admission for educational institutions should be continued.

A somewhat similar statement is made by the Heat Measurements Section:

In general, it has been much more satisfactory to purchase material not adapted for quantity production, from foreign makers. American manufacturers have been little interested in apparatus for which the demand is limited and their prices have been excessive for this class of instruments. Even a small change in a standard instrument involves disturbance of the routine and necessitates a large charge, while the foreign maker adjusts himself much more readily to such changes. It should be added, however, that where European instruments are sold through an American agent the agent's profit absorbs most of the foreigner's advantage.

Another point of view is expressed by the High Temperature Section of the bureau:

A moderate tariff on scientific instruments and no exemptions to universities or educational institutions. Many universities resell their imports to the students either in the guise of laboratory fees or breakage fees. For fairness to all—either no tariff or a tariff for everyone.

The Clay Products Section states:

It has been proven during the last three years that scientific instruments of high grade can be made by American manufacturers. There are, of course, exceptional cases where precision instruments of special design may have to be imported. We are opposed to the free admission of apparatus for educational institutions as being an unfair and antiquated practice no longer applicable under the present conditions. American manufacturers should be protected, and this is the only way in which a strong domestic industry of this kind can be developed.

Leeds & Northrup, manufacturers of electrical instruments, relative to the duty-free clause have this to say:[1]

It is not so much the monetary value of the duty-free imports of scientific instruments that has prevented the growth of the scientific instrument business, but because these duty-free instruments have gone out into educational institutions, where we will get our future technically trained men for the industries and for research. These men, as a consequence, have been trained in the use of foreign rather than American instruments. As a result, when they go into industrial or research work they are already biased in favor of the foreign apparatus with which they were trained. Scientific instruments are used either for research and educational work or for control of industrial processes. We can only trail behind foreign efforts in the direction of research and scientific industrial application if we employ their instruments. If we expect this country to develop a technique in industrial processes that is not simply a copy of foreign methods, we must stimulate the production of scientific instruments in the United States.

The Crosby Steam Gauge & Valve Co.[2] finds the free importation of such instruments of less importance:

In our opinion, based upon our experience and knowledge of what several scientific schools have done, the importation of scientific instruments imported for the use of educational institutions is so small as not to have any appreciable commercial effect or influence, and is likely to be much less in future rather than more. The privilege of free importation enables such educational institutions to have samples of foreign apparatus for comparison with articles of domestic manufacture, resulting in our general benefit and advancement, rather than merely replacing domestic articles for their general use.

The preliminary information covered by this report suggests that the establishment of a single rate of duty upon a class of goods under the specification "scientific instruments," "scientific materials," "scientific apparatus," or some similar general designation, would result in inequality in adjustment between the different instruments manufactured here, and between those of which the manufacture is contemplated. The specification of scientific instruments in one group, with a single rate of duty applying to all items, does not take into account the very different competitive positions which the individual instruments or classes of instruments occupy. On the other hand, classification or individual specification of the many instruments which may be grouped under the term "scientific instruments" calls for a detailed determination of the competitive position of each instrument or group of instruments. It should also be noted that

[1] Letter of July 8, 1919.

[2] Letter of July 10, 1919.

duties on instruments not manufactured here, and on those the manufacture of which is not contemplated, are a tax upon the consumers of such articles. The present method of specification by name—for example, lenses, optical instruments, microscopes, and telescopes—could be extended to scientific instruments not now provided for by name, according to the needs of the instrument or group of instruments in question, while those of not sufficient importance for enumeration would fall, as at present, under the catch-all clauses of the Act.

EXCERPTS FROM LETTERS OF MANUFACTURERS—BUREAU OF STANDARDS' ANSWERS TO QUESTIONNAIRE—LETTERS FROM UNIVERSITIES.

COMPETITIVE CONDITIONS.

[From various Sections of the Bureau of Standards.]

In most cases both price, quality, and special characteristics led to importation. In the case of quantity importations, cheapness was the governing factor, but for high-precision instruments the high quality and special characteristics of the foreign instruments was the cause of their importation. (Chemistry Division.)

The imports were made because of cheapness, superior quality, and often exclusive make. Mirror spectrometers, quartz-fluorite apparatus, bismuth wire, were obtainable only from England, Germany, etc. Thomson galvanometers, thermopiles, were all made in Germany. (Radiometry.)

Commercially there is no need of import of gas-testing equipment since American made is far superior. Import is only for purposes of comparison. (Gas Engineering.)

Foreign instruments well made and more dependable for precision work. Instruments such as dividing engines only made as "special" in this country and hence of higher price. (Length.)

Imports due to: (a) Special quality, generally containing optical materials not made or found in United States; e. g., unusual types of glass, optical rock salt, etc.

(b) Special characteristics—exquisite precision, workmanship, most highly specialized handwork. (Spectroscopy.)

Use of imported instruments by the commercial field has been due almost entirely to "special characteristics," for example:

Frequency meters of a special type involving much hand labor.

Unipivot instruments are of special type giving great sensitiveness.

Foreign manufacturers (particularly German) have developed specialized instruments which are only used in relatively small number.

Freedom from duty has led educational institutions to choose high-grade foreign instruments because of cheapness also. (Electrical Measuring Instruments, Meters, and Transformers.)

Imports due to special quality and characteristics. Superior lenses, more attention paid to details of mechanical construction. (Microscopy of Metals.)

Imports under Gauge Section not due to greater cheapness. Foreign-made micrometer microscopes are better made and more accurate than those of American manufacturer. Foreign-made gauge blocks are being satisfactorily replaced by American manufacturers. (Gauge Section.)

The "foreigner" functions intensively, the American extensively. On this account I believe foreign instruments are devised in some cases with greater care and attention to detail and are more accurate and sensitive, for example, galvanometers, thermometers, etc. (Testing Machines.)

Imports of thermometers were due to price. Equally good are now made by the American manufacturers. (Thermometry.)

All these factors (price, quality, special characteristics), enter into the question to some extent, but the special quality of the foreign instruments is probably the most important factor. (Radio Communication.)

Cheapness was a large element in importation of analytical balances and weights. Special quality and special characteristics combined in highest precision testing balances.

Special characteristics were large element in rather small number of importations. (Mass.)

Imports of volumetric glassware were in great measure due to greater cheapness. Special quality also contributed before the war, but not now. (Volumetric.)

[From manufacturers.]

Foreign labor is cheap: Germany has a "practical monopoly" of the college trade. (Queen-Gray Co., Mar. 26, 1918.)

Up until about 10 years ago speed indicators for machinery, ordinarily called in the trade Tachometers, were almost exclusively manufactured for the United States requirements in this country. But during the past 10 years very strong competition with cheaper instruments was introduced by Germany and lately, since Germany is out of the market, by Switzerland. Tariff asked, 25 to 40 per cent. (Schaeffer & Budenberg Manufacturing Co., July 2, 1919.)

Union Thermometer Co. in 1918 exported one-third of their product of clinical thermometers. Former imports of thermometers due to less price; American quality now better. (Union Thermometer Co., July 3, 1919.)

Slocomb micrometers are used all over the world. (Ad. J. T. Slocomb Co., letterhead.)

Germany and United States principal manufacturers of micrometers. Aggressive sales campaign by Schuchardt & Schutte to sell micrometers on price basis; 10 salesmen in this country in 1913–14. (T. R. Almond Manufacturing Co., July 5, 1919.)

Wages in this country four times as high as in Germany. (Central Scientific Co., July 7, 1919.)

Imports of electrical measuring instruments have been due, in the past, to the cheapness of the foreign product. Larger market gives foreign producer the advantage of producing in larger quantity. (Leeds & Northrup, July 8, 1919.)

Prior to 1914 we could only compete with high-grade scales, as we do manufacture a better scale than is manufactured abroad, but we can not compete with the cheaper scales or any special scale. (Christian Becker (Inc.), July 10, 1919.)

Only reason for imports of balances and weights was cheapness. (Newton Balance Corporation, July 12, 1919.)

These facts indicate that the tariffs before the war were not quite sufficient to protect American industries and build up the manufacture of accurate instruments. Where the demand was sufficient to justify quantity, manufacture and the accuracy required was not great, American manufacturers have apparently been able to meet foreign competition, such as in speedometers for automobiles, cheap pressure gauges, etc. (Precision Instrument Co., July 7, 1919.)

Ten years before the war practically all pyrometers used in this country were imported from Europe. As early as 1906 I should estimate that the pyrometer business had developed in this country so that one-third of the instruments were made in America; while in 1914 I should estimate that fully 80 per cent of pyrometers used in this country were made in this country, and that as many pyrometers were exported as were imported. Even at that time, however, and in spite of the large duty prevailing, European manufacturers were able to sell in competition with American instruments. Instruments exported were not exported to Europe, but to Japan and South America. American instruments are now equal in quality. (Thwing Intrument Co., July 2, 1919.)

* * * We wish to advise that in our experience as manufacturers of scientific instruments, where we have been subject to foreign competition, it was because of the cheapness of the foreign commodity in every case. We have been subject to continued competition of foreign-made articles where their quality was greatly inferior to ours, but because of the much cheaper price to the consumer in this country, even after having paid the duty, the consumer has been led to buy the foreign article, as it would usually perform his work, after a fashion. We have been manufacturing during the last year or two one or two scientific instruments which we have made up in absolute duplicate to instruments which were imported into this country before the war. We were called upon to make up these instruments because the importation of the same was suspended on account of the war. After having made one or two lots of these instruments, we were able to ascertain our manufacturing costs and the price at which we could sell the same, with a reasonable profit. The minimum price which we could make to importers in this country, who had given

us orders for these above instruments, was from two to three times the price, including the duty, which they had paid for the same when manufactured abroad, a short time before. We are not anticipating manufacture of these instruments for the perfectly apparent reason that when importation of these instruments is again resumed by foreign manufacturers they can undersell us at least 50 per cent with the import duties now in existence. (Emerson Apparatus Co., July 16, 1919.)

We have vastly increased facilities, due to the demand made upon us by our Government (Army and Navy Departments' Medical Supply Depots). * * * Since about 1875 we started in the manufacture of scientific instruments, particularly microscopes, which could be produced in fairly large quantity, and we had to struggle hard to market them to educational institutions, who used about 85 per cent of this product, leaving us for many years no profit and lately only a very small one, especially when you consider the scientific staff which we are obliged to maintain and the skill required to produce them. (Bausch & Lomb, July 23, 1919.)

Labor conditions abroad are different from those in this country. Blown glassware, for example, is often produced by members of one family, who market their ware through brokers and dealers. Another factor that makes it essential to build up these industries in this country is the fact that to produce instruments of precision requires a certain painstaking thoroughness in workmanship which the young American has not been encouraged to practice. For example, some of the scientific instruments that have been made abroad were made by hand, and our workmen did not have the mental training to make them sufficiently skillful, and wages prevented us from educating them. With large scale production machines can be introduced that will make them more uniform and with smaller tolerance of errors than is possible with even the most skilled foreign worker. This, of course, can not be done if a large part of the market is taken from the American manufacturer, by permitting duty free importation, which brings in a competition of the lowly paid European worker. (The Denver Fire Clay Co., July 23, 1919.)

CHANGES DUE TO WAR CONDITIONS.

[From various Sections of the Bureau of Standards.]

Many, but not all, types of balances can now be made. Laboratory rheostats are bought here exclusively (at a price!). The other instruments formerly of foreign make exclusively have not been purchased since the beginning of the war, and probably could not be. All instruments under class 3 (precision wheatstone bridges, precision potentiometers, standard resistances, precision ammeters and voltmeters, colorimetric apparatus, accessory electrical apparatus—both made here and imported prior to the war) are now purchased exclusively in this country. (Heat Measurements.)

A somewhat higher grade metallographic microscope may be obtained now in the United States than before the war. The present American-made instruments do not appear as yet to be equal to the foreign-made ones obtained before the war. (Microscopy of Metal.)

Vacuum-walled vessels for thermal insulation, used especially (in scientific work) for the storage of liquefied gases, were both manufactured here and imported prior to the war. Before the war we obtained high-grade glass vessels designed for scientific work from Germany. Now we make our own when high quality is necessary. Glass, vacuum-walled food containers are made in large numbers in this country. They are usually good enough for food containers but not for all scientific purposes. We use them when high efficiency is not necessary.

Well-designed metal vacuum-walled containers are made in England. These are intended for liquefied gases. Inferior metal containers intended for food are made in this country. Practically no change due to war. (Low Temperature.)

Large numbers of Beckman thermometers are now being manufactured in this country, since the supply of German instruments has been practically cut off. The output of all kinds of thermometers had greatly increased in this country due to the embargo on importations. (Thermometry.)

American makers are now supplying practically all weights and balances except highest precision balances and some with special attachments for rapid work.

Developments are under way for producing more balances with the special attachments (some are on the market).

Highest precision balances for testing probably will be built here when needed. (Mass.)

There has been a desire to develop paper testing machines to replace those of foreign manufacture. This is especially true in regard to the micrometers and paper scales. There is a heavy demand in the paper industry for an American tensile and folding machine. (Paper.)

The necessities of war forced a great increase in the production of high-grade field glasses, fire-control instruments, and photographic lenses. This country could get on very well without importing any of class (c) (field glasses, telescopes, fire-control instruments, microscopes, cameras, projection instruments, clamps, optical benches and parts, photographic lenses, gas or mercury tubes for production of certain spectral lines—both made here and imported prior to the war) except possibly some types of photographic lenses. Class (a) (Pulfrich and Abbe refractometers, spectrometers—except certain low grade—photometer (Martin's) entirely imported before the war) must still be imported. (Optical Instruments.)

The following sections of the Bureau of Standards report that there has been little or no change since the beginning of the war in the classification of instruments falling under class A (those almost wholly of foreign make prior to the war), class B (those almost wholly of domestic make prior to the war), and Class C (those both of foreign and domestic make prior to the war): [1]

	Number of instruments reported in—		
	Class A.	Class B.	Class C.
No change in classification during the war period.			
Engineering instruments, miscellaneous materials	1	3	2
Dispersoids	5	2	1
Investigation and test of scales		2	(1)
Textile section	1		5
Magnetic measurement	1	2	8
Interferometry	5	7	5
Low temperature		1	1
Little if any change in classification during the war period.			
Gas measurements	1	5	1
Gas engineering		(2)	(2)
Practically no change in classification during war period.			
Spectroscopy	3	1	1
No actual change in classification yet.			
Colorimetry	7		

[1] No answer. [2] Practically all. [3] Only occasional imports.

[From manufacturers.]

We believe that the scientific instrument business in this country will suffer a much greater competition in the future than before the war, for the reason that all instrument factories in Europe were greatly extended to take care of war needs, and they now stand ready to greatly increase their normal peace output. This may find a foreign outlet even at no profit to help carry the already established increased overhead charges, and to keep the new and very large force of employees busy. Next to munition making, perhaps the scientific instrument business was the most extended industry in Europe for war needs. As it is also a peace industry, it is the one line above all others that will try to find an outlet in the United States and South America. (Leeds & Northrup, July 8, 1919.)

[1] See list, p. 12, and following.

To our best belief and knowledge there were no refractometers, saccharimeters, colorimeters, and polariscopes made in this country before the war and if so they were very negligible in quantity. We have had in mind for some time the manufacture of these instruments and are now undertaking their manufacture, feeling confident of our ability to produce them successfully in this country. (Bausch & Lomb Optical Co., July 22, 1919.)

TARIFF CONSIDERATIONS.

[From various Sections of the Bureau of Standards.]

It is thought that manufacturers in this country can develop paper-testing apparatus, and that it would be desirable. A high tariff on paper-testing instruments, made by Schopper, would be well. (Paper.)

Since satisfactory types of nearly all photometric instruments can now be obtained in this country, whereas formerly it was necessary to import much of it from Germany, I believe that its manufacture in the United States should be encouraged and protected. (Photometry and Illuminating Engineering.)

It is believed that with the levying of a suitable tariff on these instruments that satisfactory substitutes will be developed in the United States. (Engineering Materials.)

A protective tariff may choke scientific work by making scientific apparatus too expensive for the poverty-stricken institutions trying to do it. If Governmen institutions and universities, etc., are duty free, the American manufacturer is not much helped, as these are the largest purchasers. I think a better procedure would be the positive method of Government subsidy, and recognition, and honor, the method so successful in Germany. But a protective tariff would be better than nothing. (Dispersoids.)

Educational institutions should not be hampered in their endeavors to obtain the best instruments available for scientific research. (Microscopy of Metals.)

I believe that instruments for scientific purposes should always be imported free of duty. There should be no restrictions on scientific research. It seems, however, that American apparatus should be used for purposes of instruction when available and reliable. (Testing Machines.)

Free admission is highly desirable, at least on instruments of the highest precision, although for much work of lower precision the use of American instruments should be encouraged. (Length.)

A high tariff on these instruments would undoubtedly restrict educational and research facilities in the United States for many years. (Spectroscopy.)

No artificial restriction should be placed upon the scientific investigations of educational institutions. (Interferometry.)

There should be a tariff of at least 50 per cent on all classes, including accessories and polariscope tubes, and there should be no exemptions for educational institutions. The sugar industry of the United States is the largest in the world and all apparatus needed should be made in our own country. (Polarimetry.)

Use of commercial electrical measuring instruments, meters, transformers, etc., by educational institutions, constitutes only a small fraction of the total use in this country. Therefore, free admission for such institutions would not injure the American industry appreciably, but would be of material aid to the institutions in securing special types of apparatus. (Electrical Measuring Instruments, Meters, and Transformers.)

I believe substantial tariff protection for these industries with duty-free importation for educational and Government institutions is greatly to be desired. These remarks apply to the whole scientific-instrument industry, not merely those enumerated herein. (Chemical Metallurgy.)

American manufacturers can and should manufacture all scientific instruments required for educational and investigative work in this country. (Telephone Service Standards.)

All necessary apparatus is manufactured in this country and there is no real need for importing any for textile testing and investigating. (Textile.)

I have talked with a number of manufacturers in regard to a revision of the tariff on instruments. I think their attitude is well taken especially as regards their objection to free admission of instruments for educational institutions. Even before the war it was demonstrated that a large number of the thermometers imported were inferior to American makes, but their cheapness influenced educational institutions into purchasing them. Certain types of inclosed-scale

thermometers are now being manufactured in this country, but their output is limited on account of scarcity of skilled help and the reluctance of manufacturers to train new men, if after the war the quantities of this type of thermometer, now undoubtedly stored in foreign countries, were allowed to be dumped on the market. (Thermometry.)

In common with most chemists, as I believe, I indorse the resolution passed by the Council of the American Chemical Society at its last meeting in April of this year, which is, in part, as follows:

"The council expresses its opinion that the development of American-made glassware, chemicals, and chemical apparatus should be encouraged in every way, and that for a reasonable period of years at least the present laws allowing duty-free importation to colleges, scientific and educational institutions of chemicals and chemical apparatus be revoked."

The above resolution, I believe, was intended to include instruments as well as apparatus.

I feel, however, that through a limited embargo or licensing system or any means that will secure the end aimed at, the consumer should be protected against unduly high prices. Thus, he should not have to pay duty on articles that are not manufactured in this country.

Further, limited free importation on all articles would enable the consumer to know at all times—

(*a*) The difference in price between domestic and foreign ware and especially (*b*) the difference in quality. This last will secure a twofold purpose—

(1) It will spur the domestic manufacturers to maintain the quality of their product always at least equal to that of foreign make.

(2) If domestic manufacturers fail to maintain such quality, it will give the consumer valid reason for buying abroad and for urging in the extreme case the abrogation of duty.

The feeling that some such check is needed is evidenced by the wording of the resolution quoted above.

In further illustration of the desirability of limited free importation the following situation merits consideration: Many essential instruments are produced in such small quantities that the returns appeal to few, if any, domestic manufacturers, and if made to order here would cost far in excess of an imported article, and by reason of inexperience in manufacture might be much inferior. Past experience has shown this to be true. It would be an unnecessary hardship to impose a tax upon the consumer for such articles. (Chemistry Division.)

[From manufacturers.]

Development of manufacture of scientific instruments in United States would open opportunity to technically trained college men. (Queen-Gray Co., Mar. 26, 1918.)

Home manufacture means the placing of larger resources at the disposal of the scientist and the commercial consumer. (Bausch & Lomb Optical Co., Jan. 29, 1919.)

With reference to duty-free importation to educational institutions, this has been urged with the claim that no advance in science should be denied our American students (and) the idea that foreign-made instruments are superior to those made in this country. As the student is at an impressionable age, a lasting impression is made which the American instrument manufacturer finds hard to combat when the student has later entered commercial life and wishes to purchase instruments.

These facts indicate that the tariffs before the war were not quite sufficient to protect American industries, and build up the manufacture of accurate instruments. Where the demand was sufficient to jusify quantity manufacture, and the accuracy required was not great, American manufacturers have apparently been able to meet foreign competition, such as in speedometers for automobiles, cheap pressure gauges, etc. (Precision Instrument Co., July 7, 1919.)

* * * A tariff equivalent to the difference in the wage paid will be necessary for us to compete. I consider that granted equal wages are paid in the above foreign countries as compared with the wages of our own men, we can satisfactorily compete with foreign-made instruments. (Brown Instrument Co., July 8, 1919.)

Experience has shown that the instrument business is the most vital of any for the successful prosecution of war. The next war will be even more a war

of applied science, and, therefore, any plan of preparedness must consider every means for protecting and fostering this work. (Leeds & Northrup, July 8, 1919.)

Having been for many pears prior to 1906 a professor of physics I know that in the purchase of apparatus for institutions having the duty-free privilege, the reduction in cost was often the determining factor which compelled the purchase of foreign instruments, and that this situation was largely responsible for the slow development in America of the manufacture of measuring instruments of precision. Personally I believe the policy of allowing the importation of such instruments wholly duty free is a mistake. If educational institutions are unable to pay the full price, other means of endowing them would be provided. We ourselves are accustomed to give a special discount to educational institutions, especially since we know that in nine cases out of ten they can by reason of direct contact with us obtain apparatus more nearly suited to their requirements than the stock apparatus which they would obtain from Europe; moreover, there is a great saving of time, and I believe that with the habit of buying at home once formed, foreign apparatus would not ordinarily be imported, except when it could not be duplicated in America. (Thwing Instrument Co., July 2, 1919.)

As to permitting scientific instruments or testing machinery, etc., free of duty into this country for educational purposes we do not see that this is necessary as it only tends to put a damper on the inventive genius in our own country so that we can not compete.

Where an article is made in large quantities and processes of manufacture can be thoroughly systematized there seems to be little difficulty in competition, but where, as in the scientific instruments and testing machinery, the various machines are built to order and in small quantities, the cost can not be reduced to compete with low-priced labor.

Owing to insufficient protection before the war a large amount of scientific instruments were imported, and owing to low prices thus only obtainable from the other side, and this caused considerable difficulty, which instrument makers and machine builders had to overcome, and we certainly believe that with proper protection and elimination of free entry on instruments for educational institutions, etc., this country will be in position to supply almost any class and type of instruments. (Tinius Olsen Testing Machine Co., July 15, 1919.)

High tariff necessary to protect from foreign competition. (Wm. Gaertner & Co., July 15, 1919.)

A high import duty will be required to protect this industry (pyrometer porcelains and refractories). In 1914, it was possible to import porcelains for pyrometric purposes, with duty and all other charges added, at a price of about 90 per cent present production costs of American-made goods. We recommend a duty on manufactured porcelain ware for scientific and industrial purposes, of not less than 75 per cent, previous duty having been fixed at 55 per cent.

The indicators (pyrometric), which now cost us around $60 to produce, are of equivalent quality to those which we could import in 1914 at a price of $36, which included a 45 per cent duty and all other charges. Assuming that the price for similar instruments will be higher abroad than 1914, we believe that a duty of not less than 75 per cent will be required.

The American-made product (platinum and platinum-rhodium thermo-element wire) of the grade required for pyrometric purposes is available only at higher price than that for which it can be imported.

We recommend a duty on the alloy 90 per cent platinum and 10 per cent rhodium, in manufactured form. We recommend that no duty be placed on pure platinum. (Charles Engelhard, July 17, 1919.)

Unquestionably, our industry would be wiped out completely unless the tariff were very quickly changed. This definite and positive statement is based on the following facts:

The increase in the cost of production of scientific instruments in this country has exceeded the increase in the cost of production in Germany—approximately 100 per cent. The cost of production of these instruments in Japan does not represent one-fourth of the cost of the production of the same article here and about one-half of what we estimate is the cost of production in Germany.

We are particularly interested in thermometers for testing purposes, such as oil-testing thermometers; high-temperature thermometers for laboratory pur-

poses, especially those used in so large quantities in explosives and dyestuffs industries. During the war we largely increased our plant, and employ now between four and five hundred men, half of whom will have to be laid off if Japanese and German goods reach this country in any quantities.

One of the largest items which we manufacture is fever thermometers, on which the duty should be at least 80 per cent. (C. J. Tagliabue Mfg. Co., July 18, 1919.)

The present condition of the scientific instruments industry in this country is excellent, as well as its future, providing, however, that we continue to be protected as we have been since the outbreak of the war so that foreign competition can be kept out. This can only be done by the elemination of the duty free privilege set forth in paragraph 573 and a protective duty of 45 per cent. (C. H. Stoelting Co., July 25, 1919.)

DUTY-FREE IMPORTATIONS.

[From manufacturers—estimated amount.]

On certain types of apparatus, such as high-grade optical and precision instruments, we believe that from 50 to 60 per cent of the entire consumption was imported duty free for educational institutions. (Central Scientific Co., July 7, 1919.)

Duty-free importations represent about 5 per cent of the total consumption. (Brown Instrument Co., July 8, 1919.)

It is probable that the total consumption in the United States is many times greater than the proportion imported duty free, but as stated before it is not the amount of duty-free importations that is serious but their effect. (Leeds & Northrup, July 8, 1919.)

In 1914 at least 50 per cent of the precision balances and weights used in educational institutions were imported duty free. (William Ainsworth & Sons, July 8, 1919.)

In our opinion the proportion of the total consumption in the United States represented by that of institutions which import without payment of duty is probably not so high as formerly. The exact proportion we are unable to ascertain. There are more pyrometer tubes and more common porcelain shapes produced now than were locally produced in 1914. Imports were practically lacking or negligible so far as common refractory and laboratory shapes composed of fused alumina of silicon carbide are concerned. (Norton Co., July 14, 1919.)

[Resolutions passed by the Council of the American Chemical Society.]

"After extended discussion, the council expressed its opinion that the development of American-made glassware, chemicals, and chemical apparatus should be encouraged in every way, and that for a reasonable period of years, at least, the present laws allowing duty-free importation to colleges, scientific, and educational institutions on chemicals and chemical apparatus be revoked." (From minutes, meeting of Council of the American Chemical Society, New York, Dec. 14, 1918.)

It was voted that paragraph 1 [above paragraph], page 3, of the proceedings for 1919 shall be modified so that the minutes of the council for December 14, 1918, shall have added to the paragraph above named the following:

"The council also expressed its opinion that duty-free apparatus and chemicals has been a very effective form of foreign propaganda in creating in the mind of the youth of this country an impression of the superiority of such foreign-made material." (From minutes, meeting of Council of the American Chemical Society, Buffalo, Apr. 7, 1919.)

[From universities.]

I wish most earnestly to protest any action looking toward the repeal of the law in question. I believe that it is of the first importance that scientific instruments for the use of educational institutions should be admitted free of duty into this country. (Jefferson Physical Laboratory, Harvard University, July 11, 1919.)

I trust no action will be taken toward the repeal of the provision for the free admission of scientific instruments. Such action at the present time would, in my opinion, work great hardship to various educational and scientific institutions, which would hardly be offset by any incidental benefit to American manufacturers. (Harvard College Observatory, July 11, 1919.)

There are, of course, a good many sides to this question, and undoubtedly State universities would like to contribute as far as possible to the upbuilding of a home supply for this class of material.

. The fact remains, however, that appropriations are usually limited, and there is no doubt that if a high tariff were placed on these commodities many of the instruments desired and required for best educational advancement would not be procured. Our past experience has been that the American cost of this class of material, especially in the development stage, or in the manufacture of a limited output, is greatly in excess of foreign scientific instruments and more than we can pay to obtain them.

It is also true that developments are made in foreign countries and due to the limited output, the American manufacturer does not care to take up the manufacture of these unprofitable items. In case of this kind it certainly would be to the benefit of educational institutions and people of this country to be able to purchase at as low a cost as possible so as to encourage the use of the latest and most improved type of instruments and apparatus.

Inasmuch as the results of research work of the universities are freely given back to the people, the cost of apparatus and scientific instruments to universities should be as near the cost of production as possible, and should be obtained from the best possible source in regard to workmanship, material, and cost.

In view of the above situation, we desire to register our opinion favoring a continuance of the policy of duty-free importation of scientific instruments and apparatus to educational institutions. (The University of Wisconsin, July 14, 1919.)

We have been considering the letter relative to the possible repeal of that clause in the present tariff law under which educational institutions may import materials and scientific apparatus duty free.

This clause was inserted in the tariff law under the fundamental idea that the "means of education should forever be encouraged," and consequently, since educational institutions are in no sense commercial competitors of manufacturing industries, it was the duty of the Government to assist such institutions in securing the best quality of materials and scientific apparatus with the least expense. It has been the policy of this laboratory for many years to so regulate the fees charged students that the income thus derived would just about pay for the cost of the apparatus and materials used. Whenever materials and apparatus of the necessary degree of purity and accuracy could be secured in this country it has been the policy to purchase from American manufacturers unless the prices asked were considered unreasonably high. In the movement now on for the repeal of the duty-free clause, which movement is primarily backed up by commercial interests, there are some men high in the councils of the American Chemical Society who would stoop to cry "pro-German" against anyone connected with an educational institution who objects in any way to the repeal of this duty-free provision. The unanimity with which the scientific laboratories as well as the talent of the teaching staffs of our universities were unhesitatingly placed at the service of the Government during the war should be sufficient answer to any implication of disloyalty of these institutions which might be made by any whose desire for excessive profits places this consideration above all other ideals. If American manufacturers would show their desire to cooperate with our universities by agreeing to furnish educational institutions with such materials and scientific apparatus as they manufacture at cost "f. o. b. factory" plus 10 or even 20 per cent profit, there would, we feel, be no objection raised by any of these institutions to the repeal asked for by these commercial interests. (Department of Chemistry, University of Michigan, July 14, 1919.)

I am strongly in favor of the repeal of the law permitting the importation into this country of chemicals, glassware, and instruments for educational institutions, duty free. I believe that the scientific men of this country had become deeply impressed with the idea that instruments of precision, pure chemicals, perfectly graduated glassware, could be made only in Germany. This has been demonstrated during the present war to be false.

There is, so far as I know, no evidence that the manufacturer of scientific instruments has imposed excessively high prices upon educational institutions. I am in favor of the United States being sufficient unto itself along all lines of scientific work. This could not be the case so long as we depend, as we did largely before the war, upon Germany, not only for our apparatus but even for our scientific opinions.

I am in favor of the repeal of the provision granting the importation of scientific instruments, pure chemicals, etc., by educational institutions, duty free. (Medical School, University of Michigan, July 17, 1919.)

I am writing to urge the defeat of the proposed repeal of the provision for the duty-free admission of scientific instruments for educational institutions. The reasons for my position are so obvious that I can not understand the source of the desire to repeal this provision.

First, if we can get good instruments from abroad cheaper than at home, we are frequently enabled to purchase a larger variety than otherwise possible, and hence to accomplish more and better work in the field of research as well as that of instruction.

Second, if we can purchase better instruments abroad than at home, we stand just that much better chance of success in research work.

Third, if, as sometimes happens, we can purchase important apparatus abroad which can not be purchased here at any price, the gain and chance of success is even still greater.

Finally, the importance of research work to the industries of this country at the present time is so thoroughly recognized that it needs no argument, and every possible aid should be given to the educational institutions of the country to secure the necessary instruments and apparatus at the lowest possible price. (The Engineering School, Harvard University, July 19, 1919.)

May I express my own view that the present system of free entry of such instruments should be continued. It seems to me that every possible handicap should be removed from our educational institutions. The present financial burdens of our universities, and educational institutions in general, are almost overpowering with the increase in general expenses, and this is coming at a time when the necessity for education of the best type is more pressing than ever before in history. (President, Leland Stanford Junior University, July 18, 1919.)

Regarding this matter, and on behalf of this department of Stanford University, I desire to say that we should consider it distinctly undesirable that this act should be repealed, thus resulting in a very considerable increase in the price paid for scientific equipment when imported from Europe. The reasons might be given at great length, but the matter reduces itself in the last analysis to the question of the cost of scientific education and, hence, to the cost of equipping our present generation of young people for effective work in scientific and industrial lines, and especially with a view to world-wide competition in all matters in which science and industry form a controlling or important feature.

After giving this matter considerable thought I can not believe that either the additional income to the Government or the anticipated advantage to the American manufacturers of similar apparatus would justify the repeal of this provision with its consequences on the cost of scientific education. In this connection it should further be noted that in very many cases instruments and scientific material contemplated in this provision can not be obtained at all in the United States, and the only result of the repeal of this provision would be, therefore, a tax on scientific education, with an entirely negligible increase in the receipts from imports. Having in view a wise national policy, and looking forward to our participation in world-wide trade and industrial competition along scientific and industrial lines, the best scientific training for the youth of our country will be none too good, and we can not afford to place on such education any unnecessary taxes. (Department of Mechanical Engineering, Leland Stanford Junior University.)

If we decide it to be sound national policy to tax all imported equipment used in educational institutions solely by students, no one in favor of protective tariffs will, I presume, demur. It is only just, however, to remember in this connection that our educational institutions are not turning this privilege of free importation to financial advantage in the sense that they in any direct way profit by it, for the small rentals requested of students for some of this apparatus barely are sufficient to replace the instruments when outworn. Moreover, for many of these instruments no rentals whatever are charged, because each student uses the instrument only a very few times in the course of his training in particular subjects. If the budgets of all educational institutions could be increased sufficiently not to entail hardship, the levying of duties on articles now imported free would, to be sure, be a minor matter. But it is decidedly unlikely that these increases will or can be obtained in many insti-

tutions, and hence our educational institutions are bound to be hampered in their work for some years following the imposition of duties. Nor would our institutions be hampered temporarily only, for no duty, however high, could stimulate the manufacture of scientific instruments used in such small numbers that a single firm can more than supply the demands of the entire world. Examples of such equipment and instruments are special models, microscopes, and saccharometers—and others easily come to mind. Under these circumstances it would be unremunerative to manufacture these instruments in every country. Sometimes a particular kind of instrument is required by a few investigators only, and these often could not be provided without the violation of international obligation. (Laboratory of Human Anatomy, Leland Stanford University, Aug. 8, 1919.)

If our foreign purchases were to be limited to Germany we should feel no hesitation in urging the repeal of free admission for such apparatus. It must be remembered, however, on the one hand that even before the war England and France had disputed the preeminence of Germany in such manufactures, so that as a matter of fact our trade was more and more going to these countries; and on the other hand that the demand for certain types of apparatus, such as optical instruments used in research alone, is so small that no amount of protection could be expected to promote its manufacture in this country, while the apparatus which has commercial uses and is therefore in great demand (such as many types of instruments for electrical measurements) is already made in this country at such low prices and of such great excellence that no foreign country can compete with it.

Considering these facts, we feel that on the whole it would be unwise to repeal the provisions of the act of 1913 relating to such apparatus. (Department of Physics, University of California, July 25, 1919.)

There can be no question that the success of American scientists in competing with foreign, and especially with German scientists, has been due in appreciable measure to the facility with which foreign scientific apparatus has been obtained. All of the chemical industries of the country are absolutely dependent upon a large number of well-trained scientists entering the industries every year from the universities. These men should be familiar with apparatus of all types, and while it is true that at the present time there are many cases in which apparatus produced in this country is superior to that produced abroad, it is very essential that the universities should have a free choice and should be able to compare the types of apparatus designed and manufactured in various countries.

There is no question to my mind that the repeal of the provision in question would not only be a serious detriment to scientific work in the university but would even be, in the long run, disadvantageous to the very companies that are manufacturing scientific apparatus in this country. (Department of Chemistry, University of California.)